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124  
United States  
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Forest Service

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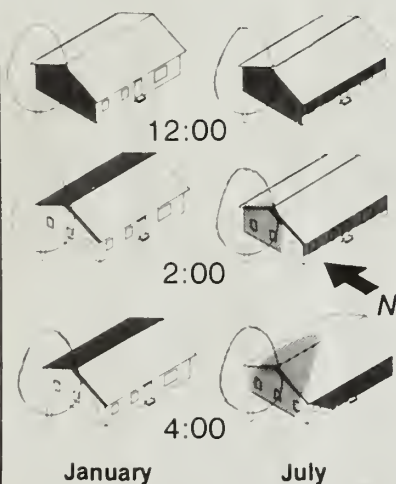
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Using Trees to Reduce  
Urban Energy Consumption:  
Transferring Technology to Users

Urban forests are desirable for their esthetic value and for the shade they provide in metropolitan areas. The Forest Service is investigating ways by which both the trees and their accompanying shade areas may be utilized to reduce urban energy consumption.

Forest Service scientists in the Northeastern Station's Research Work Unit NE-1651 in University Park, Pennsylvania, in cooperation with the Pennsylvania State University, have shown that in urban areas, the microclimate produced by trees around buildings may either increase or decrease energy use for heating and cooling depending on tree form and arrangement.

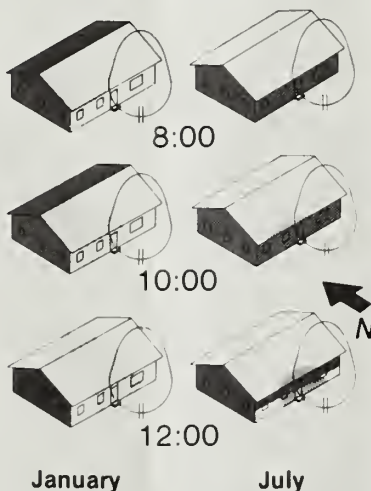
Due to the upward trend of annual U.S. heating and cooling costs, many researchers recommend the placement of selected deciduous or coniferous trees to the west of the home, not to the south as popularly believed. Research since the 1950's indicates the need to consider solar angles in tree placement. The location of trees to the west provides the optimal position to reduce solar radiation on the house in the summer without significantly decreasing radiation in the winter. Trees on the west may also block winter winds which primarily come from the north and the west.

**TREE ON WEST**



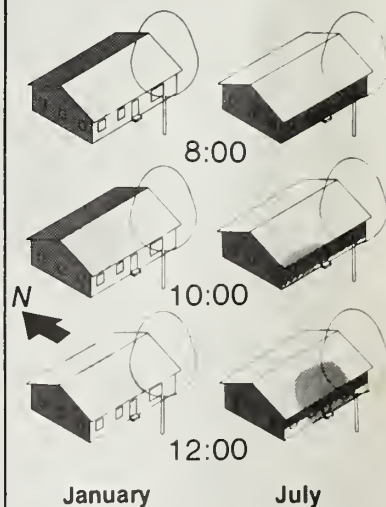
*Trees on the west provide good shade in summer but shade only a small area in winter.*

**TREE ON SOUTH**



*Trees on the south shade little in summer, but shade a large area in winter.*

**PRUNED TREE ON SOUTH**



*Taller trees with the lower bole pruned shade more in summer and shade a smaller area, including less of the south-facing windows in winter.*

In 1982, the 60 million single-family detached homes and mobile homes in the U.S. had an average expenditure of about \$640 for heating and cooling which amounts to \$38 billion nationwide. Forest Service sponsored research shows that the potential for annual energy saving through use of trees is on the order of 20 or 25 percent for conventional houses that are protected from sun and wind by a carefully planned arrangement of trees. An experiment was conducted in the Northeast over most of one heating season to determine the effect of a single-row windbreak on the rate of air infiltration and energy use in a small mobile home. Air infiltration was reduced by an average of 54 percent when the windbreak protected the home from the prevailing winds. Heating energy use was reduced by 18 and 17 percent at one and two tree heights from the home. The windbreak also reduces heat energy use seasonally by about 12 percent compared to an open site. Thus, trees may provide substantial energy savings.

In 1980, the Forest Service developed a FORTRAN IV program consisting of one main program (CROWN) and three subroutines (SPHELP, LOCATE, and PMAP) to map tree crown shadows in the urban forest. Although previous work in shadow mapping has been carried out for rural forests, this program is one of the first to take special consideration for the shape of the shadow cast by each tree crown at significant times and dates in the urban area. The program will eventually be converted to BASIC for the personal computer.

Researchers from NE-1651 and Pennsylvania State University have transferred information concerning the amenities of trees through numerous publications, workshops, symposia, and presentations. In the Northeast, results of the research are being incorporated into national, state, municipal, and private organizations. Additional information has been published for landscape architects, planning professionals, urban foresters, engineering organizations, and homeowners.

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